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a result of these comparisons, it may be concluded that the hypoglossal nerve of the Sauropsida and Mammalia is not a separation from the anterior roots of the vagus, but is formed by the coalescence of a number — probably three — of anterior spinal nerves.

Since the completion of my manuscript, the last number of the *Archiv für anatomie und physiologie* has been received; and therein is a paper by Professor Froriep of Tübingen, dealing, among other things, with this very point as to the origin and morphological relations of the hypoglossal. His observations were carried on by means of sections through very young sheep and cow embryos; and he was able to perceive that the hypoglossal at an early stage consisted of three distinct parts, which eventually unite; the union occurring first near the origin of the nerve, and proceeding centrifugally. To emphasize the similarity between Froriep's results based on embryological data, and my own deduced from anatomical facts, it will be well to quote a sentence from his paper. In summing up, he says, "The hypoglossus is formed by the union of a number of segmental spinal nerves, each of which is composed of two roots, — a ventral and a dorsal, — exactly like spinal nerves."

J. PLAYFAIR MCMURRICH.

Johns Hopkins university, Baltimore, Md.

The Wisconsin bill relating to the instruction of deaf-mutes.

In *Science* (vol. v. p. 324) you state, that, until the present year, no special provision had been made in Wisconsin for the education of deaf-mutes. This is a mistake. The Wisconsin institution at Delavan, one of the best in the country, has been in successful operation since 1852, and two private schools are also in existence. The returns of the recent census, however, have shown that a large number of the deaf children of Wisconsin are growing up in ignorance, and that existing provisions for their instruction are inadequate. The bill that has just passed the Wisconsin legislature is an attempt to remedy the evil by a change in the policy of the state towards her deaf and dumb. The new plan may be tersely described as the policy of decentralization. The old policy of centralization — that is, the policy of collecting into one school all the deaf-mutes of a state — has everywhere failed to bring under instruction a large proportion of the deaf-mutes of school age. For example: there were in the United States in 1880, according to the last census, 15,059 deaf-mutes of school age (six to twenty years); while the total number of deaf-mutes returned as then in the institutions and schools of America was only 5,393, and many of these were beyond the school age. A similar result is obtained when we examine the statistics of each state taken separately.

Parents have a natural reluctance to part with their deaf children, who, more than others, require home care and attention. But education in an institution involves separation from home. Some parents will not part with their children excepting on compulsion; others delay the separation until the most impressionable period of life has been passed; and still others deprive their children of education on account of the value of their labor at home.

The nearer the school can be brought to the home of a deaf child, the less likelihood is there that he will escape instruction. The promoters of the Wisconsin bill believe that in many of the incorporated cities and villages of that state the deaf children

could, with limited state aid, be educated in the localities where they reside; and that, if day-schools were established wherever possible, the institution at Delavan would be able to accommodate all who could not attend a day-school.

The bill grants state aid to any incorporated city or village supporting a school for deaf-mutes, to the extent of a hundred dollars per annum for every pupil instructed. The state appropriation alone will probably be sufficient to provide a teacher for a school of four or five deaf children; but even a school containing only one deaf child, which, of course, would have to be supported mainly from local sources, may, by complying with the provisions of the bill, receive state aid to the amount of a hundred dollars per annum.

Under such a law, there should be no excuse for lack of instruction. Public opinion will probably compel the education of deaf-mutes: for, if allowed to grow up without instruction, they very easily become dangerous members of society; while, if educated, they become good citizens, amenable to the laws of society, and sources of wealth to the state. If only as a measure of economy, the Wisconsin bill demands consideration; for the average per capita cost of the education of a deaf child in an American institution exceeds two hundred and twenty-three dollars, whereas the cost to the state, on the Wisconsin plan, is limited to a hundred dollars.

But other considerations are of still greater importance. It certainly seems reasonable to expect that the Wisconsin plan, consisting of a central institution and a large number of small day-schools scattered throughout the state, will bring under instruction a larger percentage of the deaf children of school age than would be possible on the institution plan alone. Instruction can also be commenced in the day-schools at an earlier age than heretofore; so that many pupils could receive preparatory instruction in a day-school before entering the institution, and thus be enabled to receive from the institution a higher and better education than they could otherwise hope to obtain.

ALEXANDER GRAHAM BELL.

Washington, D.C., April 27.

A complete fibula in an adult living carinate-bird.

The only known bird with a complete fibula is the Jurassic Archaeopteryx (Marsh, Dames). The fibula of all birds is complete during the early life of the embryo. I find in an adult *Pandion carolinensis* of Prof. O. C. Marsh's collection an entire fibula, but with the distal end of it not in front of the tibia, as in *Archaeopteryx* (Marsh). It would be interesting to examine the embryos of this bird; and I will be very much obliged to anybody who can send me any of them.

DR. G. BAUR.

Yale-college museum, New Haven, Conn.,
April 24.

Digestion experiments.

I have read with some surprise the comments by Dr. E. Lewis Sturtevant in *Science*, April 24, upon my article on 'Errors in digestion experiments,' inasmuch as I had no intention, in that article, of asserting or implying any thing whatever in regard to other experiments of that character in this country. The purpose of the article was to call attention to the

rather large possible errors of the results of such experiments; and for that purpose I used the material nearest at hand. In order, however, to prevent any further misapprehension, I desire to say that I fully concede Dr. Sturtevant's claim to priority; although, owing to the fact that the bulletins of the New-York station are to be had at first hand only through the press of that state, I was not aware, at the time my results were first published (Bulletin No. 3 of the agricultural experiment-station of the University of Wisconsin, June, 1884), that he had anticipated me by three or four weeks.

I fully appreciate his remarks regarding the value of recognition, on the part of science, of scientific work at experiment-stations, and should regret exceedingly to seem to fail of doing whatever in me lies to secure such recognition. The field of agricultural science is too wide, and the workers in it far too few, to justify any professional jealousy.

H. P. ARMSBY.

Madison, Wis., April 30.

Tertiary phosphates in Alabama.

Since the publication of my two notes in *Science* last year, respecting the occurrence of phosphates in the cretaceous formation of this state, we have found that they occur also at at least two distinct horizons in the tertiary formation.

This formation in Alabama shows the following well-marked subdivisions, given in descending order:—

Vicksburg	175 (?) feet,	}	White limestone of Tuomey	}	Oligocene.
Jackson	60 "				
Claiborne	150 "	}	Claiborne,	{	Eocene.
Buhrstone	175-200 "				
Lignitic	1,000 "		Lignitic and flatwoods of Hilgard,		

The upper of these two divisions consists mainly of limestones, called throughout the country, and by Professor Tuomey, the 'white limestone.'

The lower division consists of sands and clays, which make up the greater proportion of the thousand feet or more of the strata of this group; but interstratified with these are five or six, and perhaps a greater number, of beds holding marine shells, the aggregate thickness of which may perhaps be given at a hundred feet.

Mr. D. W. Langdon, jun., of the state geological survey, while on a collecting tour for Mr. T. H. Aldrich, made the discoveries to which this note is intended to call attention.

At Nanafalia, on the Tombigbee River, there is a remarkable series of beds, over fifty feet in thickness, made up almost entirely of the shells of a small oyster (*Gryphaea thirsae*). At intervals throughout this thickness are projecting indurated ledges, holding the same shells, but forming a tolerably compact rock. A specimen from one of these hard ledges, one or two feet thick, has been analyzed by Mr. Langdon, and found to contain 6.7% of phosphoric acid. Other parts of the *Gryphaea* beds may be similarly phosphatic, but no analyses have yet been made to show it.

This Nanafalia marl, which occupies a position nearly in the centre of the lignitic subdivision, occurs

also on the Alabama River, at Gullette's and Black's Bluffs, and crops out between the two rivers in the lower part of Marengo county, where its presence is indicated by limy spots, or 'prairies,' of very great fertility. This marl contains also a very considerable percentage of greensand, and, apart from the phosphoric acid which it contains, would have become a valuable fertilizer.

The other phosphate-bearing horizon is in the lower or Jackson division of the white limestone.

At the base of the orbitoidal limestone which forms the greater part of the bluff at St. Stephen's, Mr. Langdon finds a hard ledge of rock holding *Plagiostoma dumosa*, and immediately beneath this, and extending fifteen feet down to the water's edge, a glauconitic marl holding numerous nodules or concretionary masses of phosphate of lime, — an occurrence quite similar to that of the nodules in the cretaceous beds at Hamburg in Perry county, described last year. Mr. Langdon's analysis of the greensand marl holding the nodules shows 0.6% of phosphoric acid, while a sample of the nodules analyzed contains 22.68% of phosphoric acid.

On the opposite side of the river, in Clarke county, similar materials have been collected and analyzed. A greenish glauconitic sand, occurring some three or four miles north of Coffeetown, contains 1.76% of phosphoric acid.

Fifteen or twenty feet above this marl, there is a yellowish-brown loam holding soft yellow nodular masses varying in size from one inch to eighteen inches in diameter, and containing 2.74% of phosphoric acid. This loam is probably formed by the disintegration of the Jackson limestone, the age of

the stratum being indicated by the specimen of *Plagiostoma dumosa* which it contains.

Again: near Grove Hill, in Clarke county, one of my students, Mr. S. S. Pugh, has collected a number of phosphatic nodules which contain 19.48% of phosphoric acid.

Where the argillaceous limestones of the Jackson age form the surface, they give rise, in their disintegration, to the rich limy or 'prairie' soils which characterize my 'Lime Hills' region,¹ which occurs over a good part of the counties of Choctaw, Washington, and Clarke. It is more than probable that the exceptional fertility of the soils of this region is in great measure due to the presence of these phosphates. In the upper part of the white limestone (Vicksburg), I have not yet been able to detect any unusual proportion of phosphoric acid.

In this connection it may be interesting to note that Mr. L. C. Johnson, of the U.S. geological survey, has traced the extension of the Alabama cretaceous phosphate beds into Mississippi, along the line pointed out by me in one of my notes above referred to. The occurrences in Mississippi are quite similar to those already described in this state.

EUGENE A. SMITH.

University of Alabama, April 20.

¹ Report on cotton-production in Alabama, p. 52.